The National Database for Deep Sea Corals and Sponges: A key resource for biogeographic investigation of deep sea communities

NOAA Deep Sea Coral Research and Technology Program

Speaker:
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Outline

- Introduction to key data products of DSCRTP
- Insight into workflows and tools used for data management, quality assurance, archive, and distribution
- Brief introduction to the National Database for Deep Sea Corals and Sponges
- Initial Case Study: Deep sea coral community analysis using National Database and Marine Eco-Regions of the World
- We want to encourage you to use the data!

People - Thank you!

NOAA/NMFS/OHC/DSC-RTP (Silver Spring)

- **Tom Hourigan (program lead)**
- Heather Coleman

NOAA/NCCOS/CCMA/Biogeography Team/Deep Coral Ecology Lab (Charleston, SC)

- **Peter Etnoyer (federal lead)**
- **Robert McGuinn (data systems mngr.)**
- Janessy Frometta
- Ren Salgado
- Andrew Shuler
- Daniel Wagner

NOAA/National Centers for Environmental Information (Stennis, MS)

- **Scott Cross (federal lead)**
- **Matt Dornback (data systems specialist)**
- **David Sallis**
- **David Moffitt**
- Many others

NOAA, Office of Exploration and Research

NOAA/NCCOS/CCMA/BioGeography Team

- John Christensen (lead)
- Brian Kinlan
- Matt Poti
- Dan Dorfman

NOAA - NWFSC

- Curt Whitmire

USGS

- Kathy Scanlon et al.2010 (Cold Water Coral Geographic Database - CoWCoG)

USGS/OBIS-USA

- Abigail Benson

All of our Data Providers and Researchers !!!

* Current DSC Data Working Group members listed in black

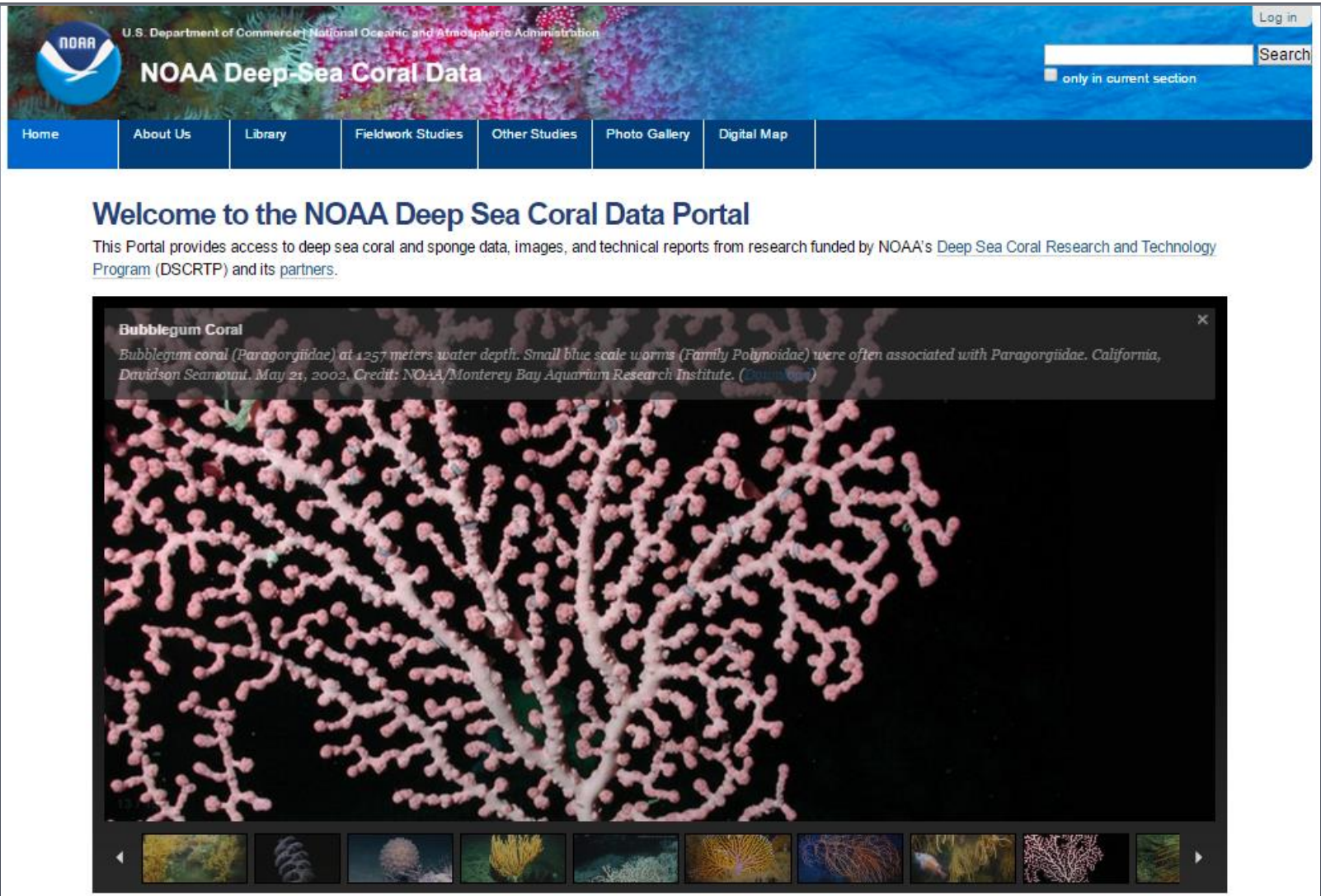
Key Products: DSCRTP Data Working Group

- National Database of DSC and Sponge occurrences
- Habitat Suitability Models
- Site Characterization Reports
- Archiving services for all cruise data and DSCRTP reports
- Delivery Mechanism: DeepSeaCoralData.NOAA.gov
  - Web Portal
  - Mapping Portal
  - ERDDAP Data Service and Web Mapping Service

Clients / Partners

- ***Fisheries Management Councils***
- Managers for MPAs (Sanctuaries and National Monuments)
- Marine Spatial Planning Processes
- Government, Academic, and NGO Researchers
- Other Stakeholders

DSC-RTP Data Portal
DeepSeaCoralData.NOAA.gov



Digital Map & Database

Data Search, Discovery & Download

The DSCRTP map allows for search, discovery, and download of the National Deep Sea Corals and Sponges Database. All points are categorized and colored by common vernacular categories. Users can search by taxon, region, time, and depth. Data downloads can be initiated using the search parameters on the map and the on-screen geographic extent. Go to the digital map

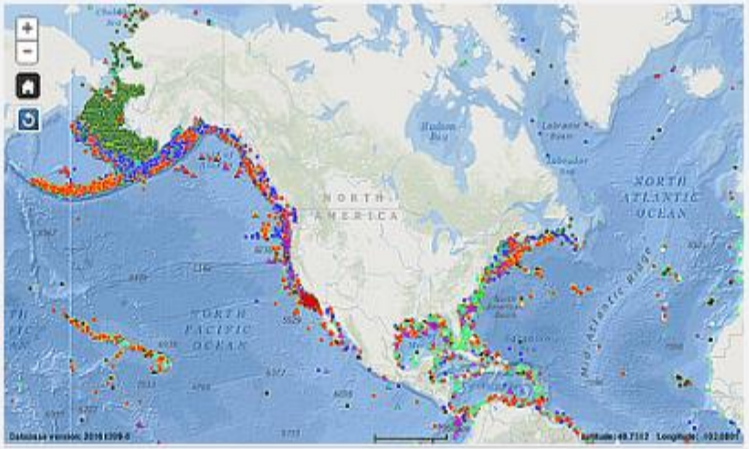
Information Access

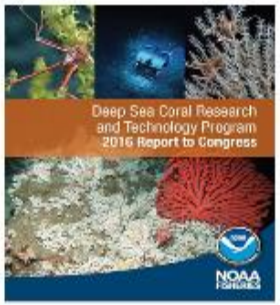
Users can also view site characterization reports for DSCRTP funded research. These reports give habitat summaries of specific undersea areas and summarize the dives on the area. Go to the digital map

Deep Sea Coral Database Documentation

DSCRTP's Technical Memo on the National Database. Go to the publication

Metadata for the Deep Sea Coral Database. Go to the metadata





2016 Report to Congress

Read the 2016 Deep Sea Coral Research and Technology Program Report to Congress.

State of DSC Report

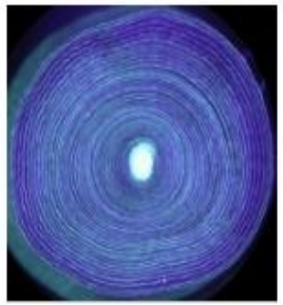
Preview the 2015 report on the state of deep sea corals and sponges in the U.S.

Research Sites

Read reports characterizing deep sea coral and sponge sites.

Okeanos Explorer

Follow the Pacific Islands explorations.

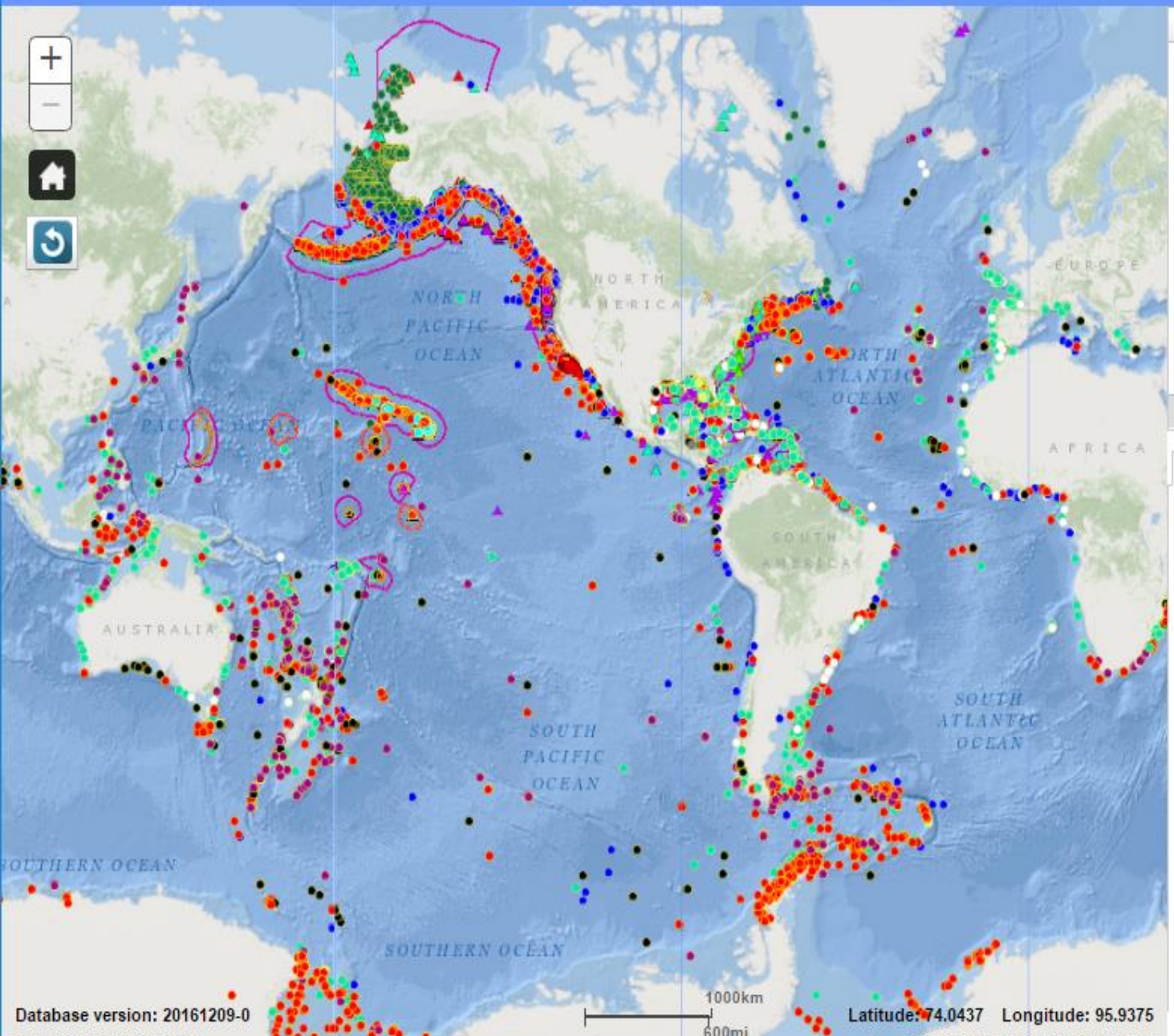


Report Archive

Visit NOAA's Coral Reef Information System(CoRIS).

NOAA Deep-Sea Coral Data

Zoom In | Zoom Out | Prev Extent | Next Extent | Pan | Stop Zoom | Geostatistics | Data Query | Data Download | Metadata | Contact Us



Database version: 20161209-0

Latitude: 74.0437 Longitude: 95.9375

Site Characterizations by US Region

- Southeast
- Gulf of Mexico
- California
- Northwest

Map Display Options

Legend | Photo

Sponges

- Calcareous Sponge
- Demosponge
- Glass Sponge
- Scleromorph Sponge
- Sponge (unspecified)

Corals

- Black Coral
- Gold Coral
- Gorgonian Coral
- Lace Coral
- Lithotelestid Coral
- Longhorn Hydrozoan Coral
- Other Coral-Like Hydrozoan
- Sea Pen
- Soft Coral
- Stoloniferan Coral
- Stony Coral (branching)
- Stony Coral (cup coral)
- Stony Coral (unspecified)
- NA

NOAA Deep-Sea Coral Data

Zoom In | Zoom Out | Prev Extent | Next Extent | Pan | Stop Zoom | Geostatistics | Data Query | Data Download | Metadata | Contact Us

Site Characterizations by US Region

- Southeast
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Map Display Options

Legend | Photo

Full Resolution Image

Deep Sea Corals (3 of 23)

Acanthogorgia sp.
(gorgonian coral)

Date:	2015-08-29	Catalog Number:	621176
Depth(m):	388	Taxonomic Rank:	genus
Position (lat lon):	19.80272 -156.12686	Sampling Equipment:	ROV
Location Accuracy(m):	20m	Location:	Main Hawaiian Islands, Hawaii Island, Keahole Pt

SampleID: EX1504L3_02_20150829T190247Z.mp4_03:59:50:39
Data Provider: NOAA, Deep Sea Coral Research & Technology Program and Office of Ocean Exploration and Research
Identification Qualifier: ID by expert from video
Citation: Okeanos Explorer (EX1504L3): CAPSTONE Leg III: Main Hawaiian Islands and Geologists Seamounts (ROV/Mapping)

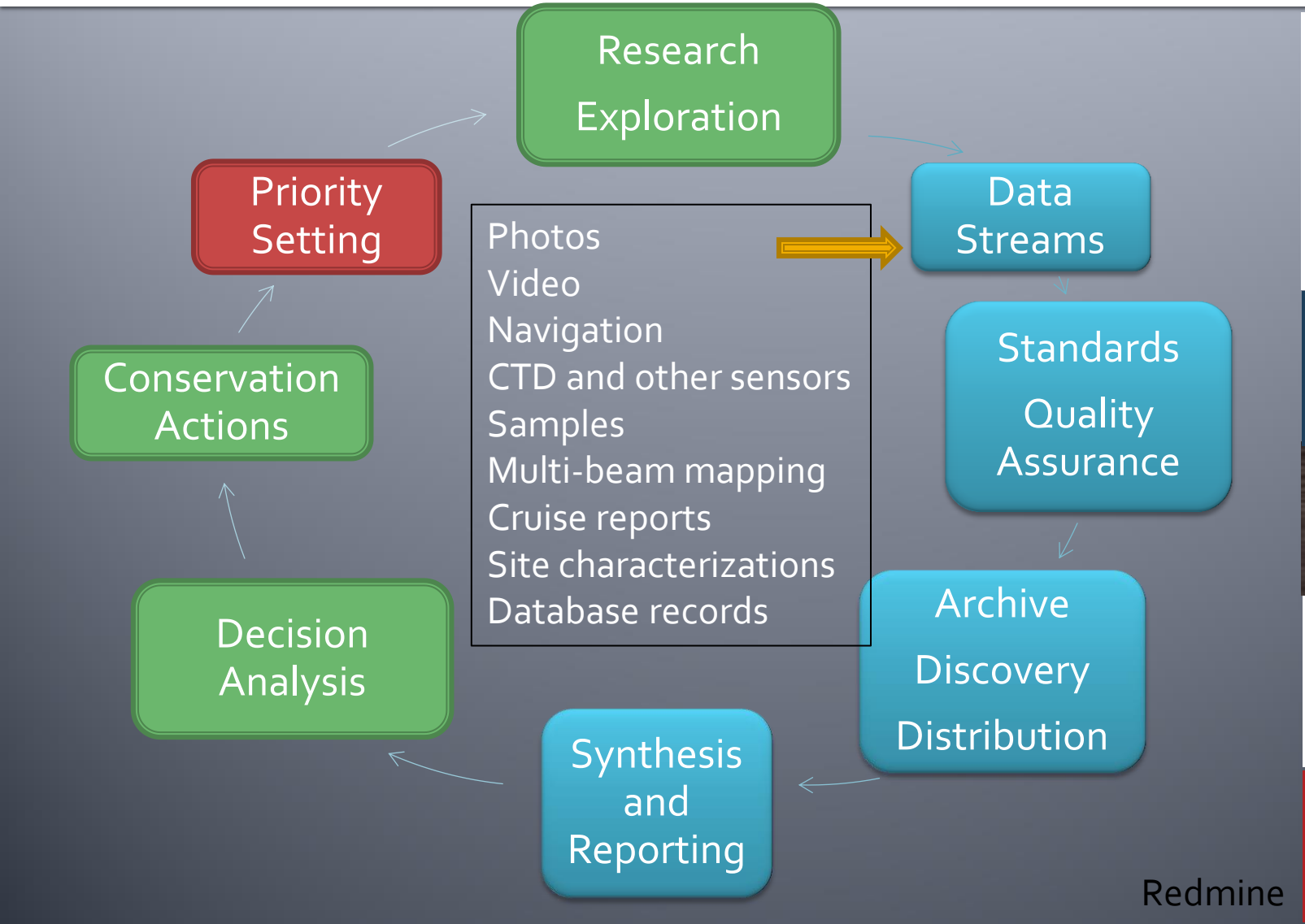
Waipio Bay
Kawaihae Bay
801
1360
Hawai'i

Database version: 20161209-0
26,509 Records Found

20km
10mi

Latitude: 20.2128 Longitude: -156.0540
Map Scale is 1 : 577,790.554

Work Flow – Data to Action



National Database (Operating principles)

- Comprehensive nationally
- Contributing internationally
- Darwin Core compliant schema, better interoperation with international standards for biological occurrence data
- Committed to a high degree of quality
- Networked with other aggregation and portal services (ERDDAP data service and WMS) Marine Multipurpose Cadastre andOBIS-USA)
- Connection points to other databases (WoRMS, GenBank)
- Future Integrations: IOOS Marine Biodiversity Observation Network Data Portal, and habitat compliance with Coastal and Marine Ecological Classification Scheme (CMECS)

Key Variables in the Database

For all records:

- Metadata regarding provenance (how did I get here?)
- Taxonomy (who am I?), with assessment of ID quality
- Position (where am I?) horizontal (lat,long) and depth, with accuracy assessment

For many records:

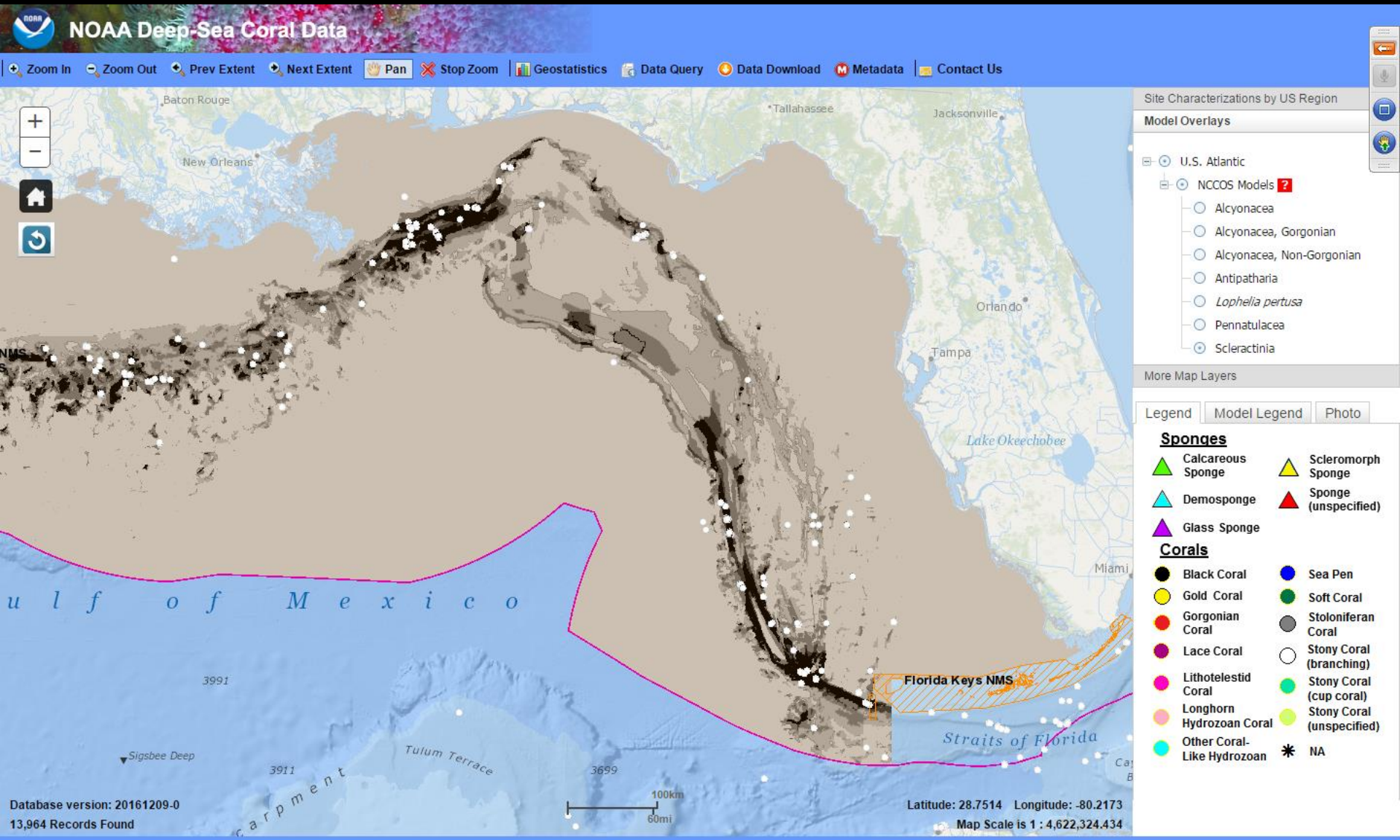
- Still Image of actual occurrence
- Habitat
- Size
- Condition
- Associated Environmental Variables (in-situ observations)
  - Temperature, pH, Total Alkalinity, Salinity, Dissolved Oxygen, Partial Pressure of CO_2, Dissolved Inorganic Carbon

- For all the details see Hourigan et al. 2015 (NOS NCCOS 191) LINK

The Numbers (*404,368 Records*)

- Caribbean: 1,359
- Gulf of Mexico: 23,924
- Mid-Atlantic: 1,380
- New England: 961
- North Pacific, 76,194
- Pacific: 232,871
- South Atlantic: 7,008
- Western Pacific: 43,026
- Outside of US EEZ: 17,645

Habitat Suitability Models



Example Application: Community Analysis

- **Questions:**
  - Are there distinctly identifiable coral community types that are apparent within and between marine ecoregions?
  - Which ecoregions have similar communities and where are the breaks between community types?
- Site designations: Marine Ecoregions of the World -MEOW (Spalding et al.,2007)
  - Biogeographic classification of the world's coasts and shelves.
  - MEOW represents broad-scale patterns of species and communities in the ocean.
  - Led by WWF and The Nature Conservancy.

Example Application: Community Analysis

- Regions with > than 100 coral observations (where taxon rank = species).
- Dissimilarity matrix was constructed using the "Chao" method (robust against sampling differences between sites).
- Software used: R "vegan" package (Okansen et al. ,2016), specifically "hclust" and "metaNMDS" functions.
- Diversity metrics were calculated for each eco-region (Figure 3).
- The number of coral observations at the species level within each eco-region is captured in Figure 4.


CANADA
North American Pacific Fjordland
Hudson Complex
Puget Trough/Georgia Basin
Gulf of St. Lawrence - Eastern Scotian Shelf
Oregon, Washington, Vancouver Coast and Shelf
Gulf of Maine/Bay of Fundy
UNITED STATES
Virginian
Northern California
Carolinian
Bermuda
Southern California Bight
Northern Gulf of Mexico
Cortezian
Floridian
Magdalena Transition
Bahamian
MEXICO
Southern Gulf of Mexico
CUBA
Greater Antilles
Revillagigedos
Mexican Tropical Pacific
Western Caribbean
Chiapas-Nicaragua
Southwestern Caribbean
Clipperton

Figure 1

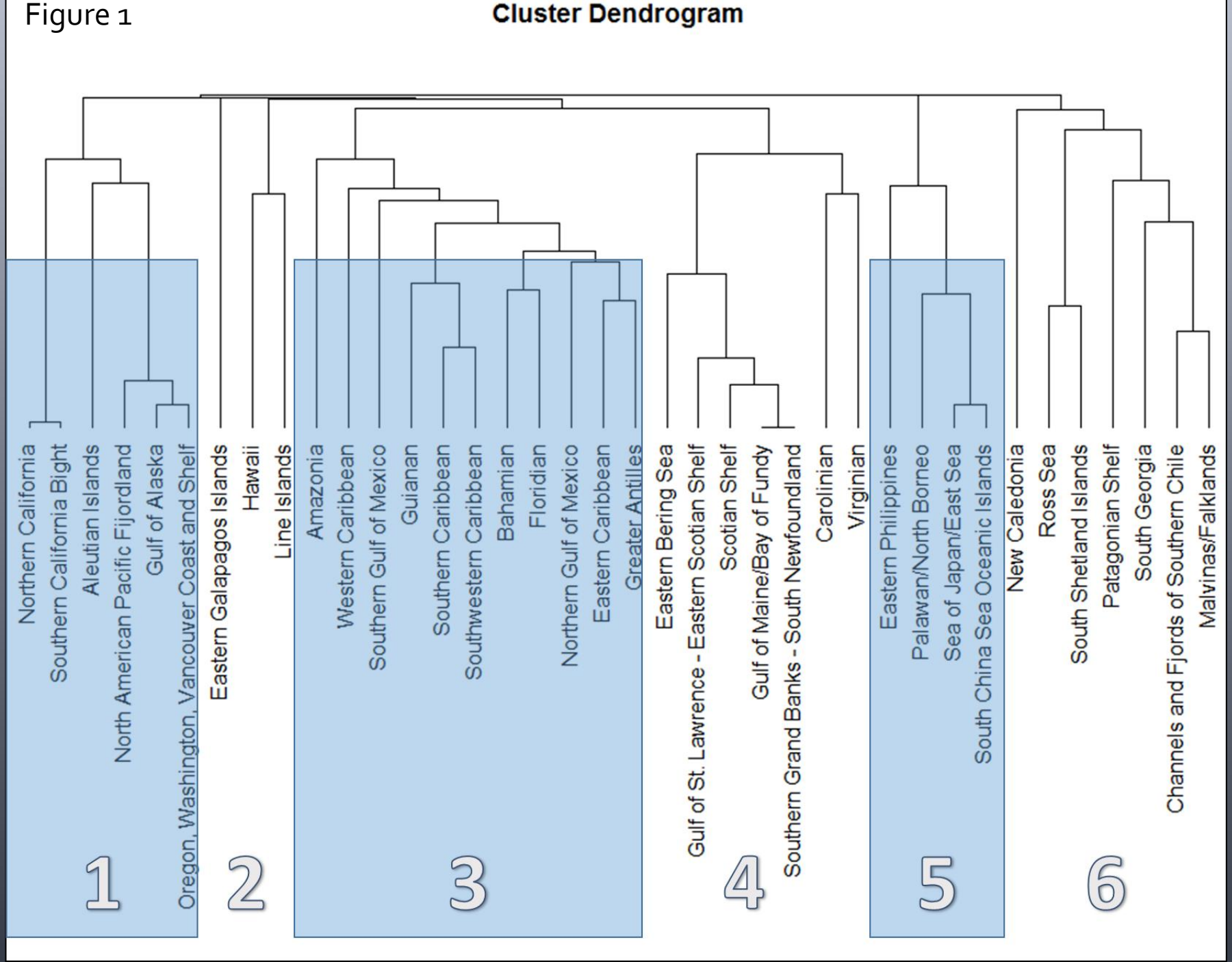
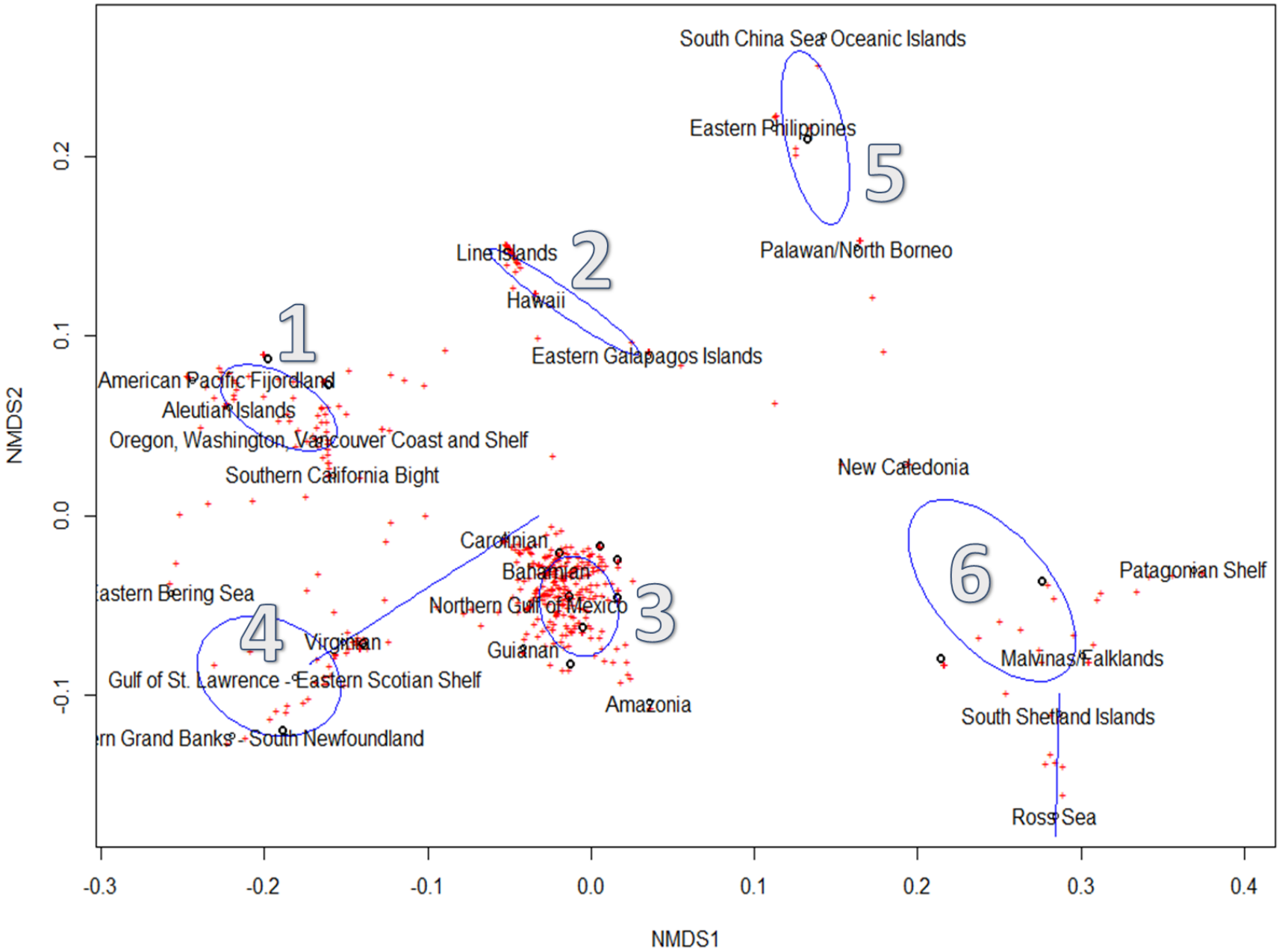

Cluster Dendrogram
Northern California
Southern California Bight
Aleutian Islands
North American Pacific Fijordland
Gulf of Alaska
Oregon, Washington, Vancouver Coast and Shelf
Eastern Galapagos Islands
Hawaii
Line Islands
Amazonia
Western Caribbean
Southern Gulf of Mexico
Guianan
Southern Caribbean
Southwestern Caribbean
Bahamian
Floridian
Northern Gulf of Mexico
Eastern Caribbean
Greater Antilles
Eastern Bering Sea
Gulf of St. Lawrence - Eastern Scotian Shelf
Scotian Shelf
Gulf of Maine/Bay of Fundy
Southern Grand Banks - South Newfoundland
Carolinian
Virginian
Eastern Philippines
Palawan/North Borneo
Sea of Japan/East Sea
South China Sea Oceanic Islands
New Caledonia
Ross Sea
South Shetland Islands
Patagonian Shelf
South Georgia
Channels and Fjords of Southern Chile
Malvinas/Falklands
1
2
3
4
5
6

Figure 2


South China Sea Oceanic Islands
Eastern Philippines
5
Palawan/North Borneo
Line Islands
2
Hawaii
1
Eastern Galapagos Islands
American Pacific Fijordland
Aleutian Islands
Oregon, Washington, Vancouver Coast and Shelf
Southern California Bight
New Caledonia
Carolinian
Bahamian
6
Patagonian Shelf
Eastern Bering Sea
Northern Gulf of Mexico
3
4
Virginian
Guianan
Malvinas/Falklands
Gulf of St. Lawrence - Eastern Scotian Shelf
Amazonia
South Shetland Islands
Grand Banks - South Newfoundland
Ross Sea
NMDS1
NMDS2
-0.3
-0.2
-0.1
0.0
0.1
0.2
0.3
0.4
0.2
0.1
0.0
-0.1

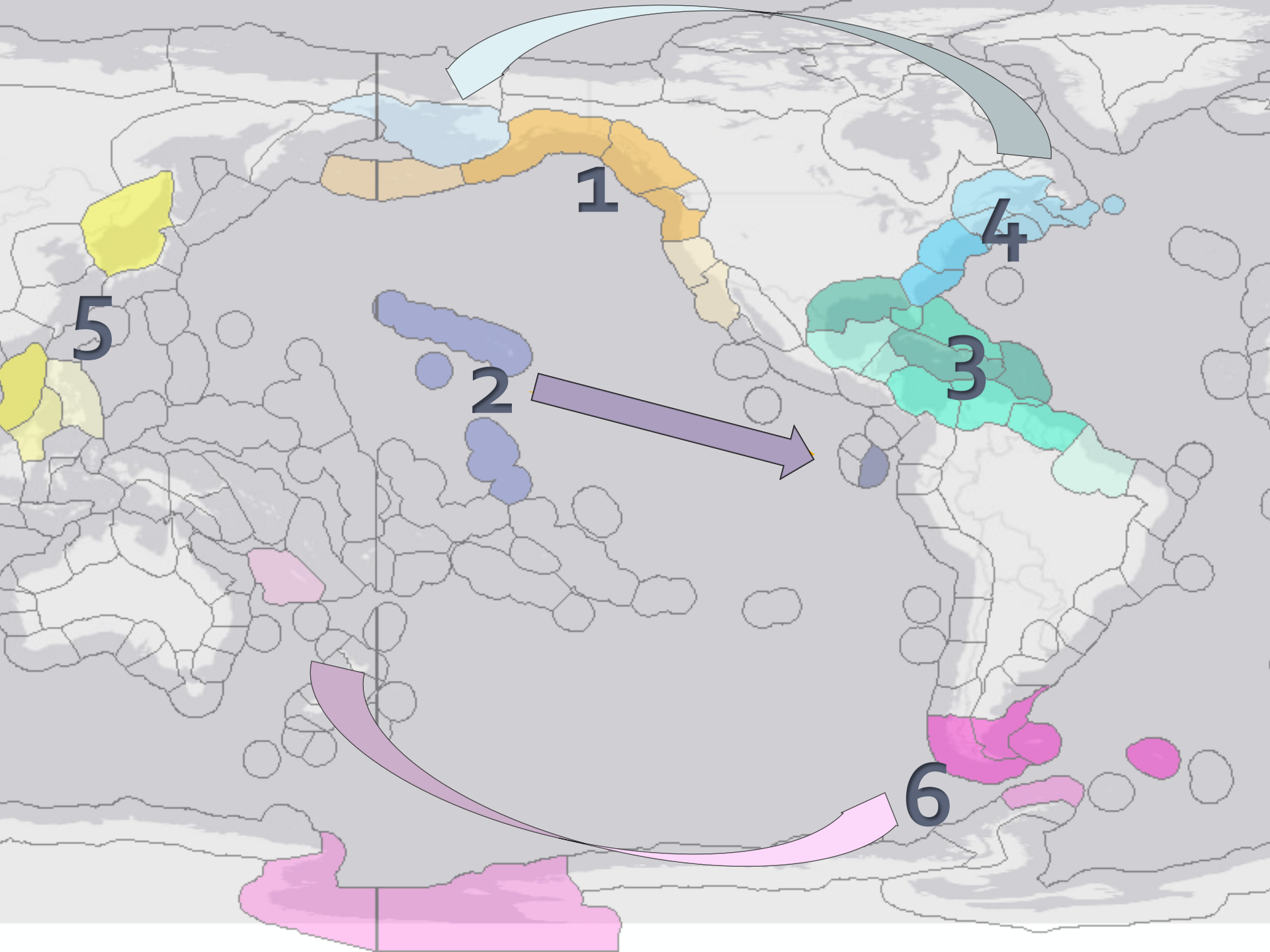
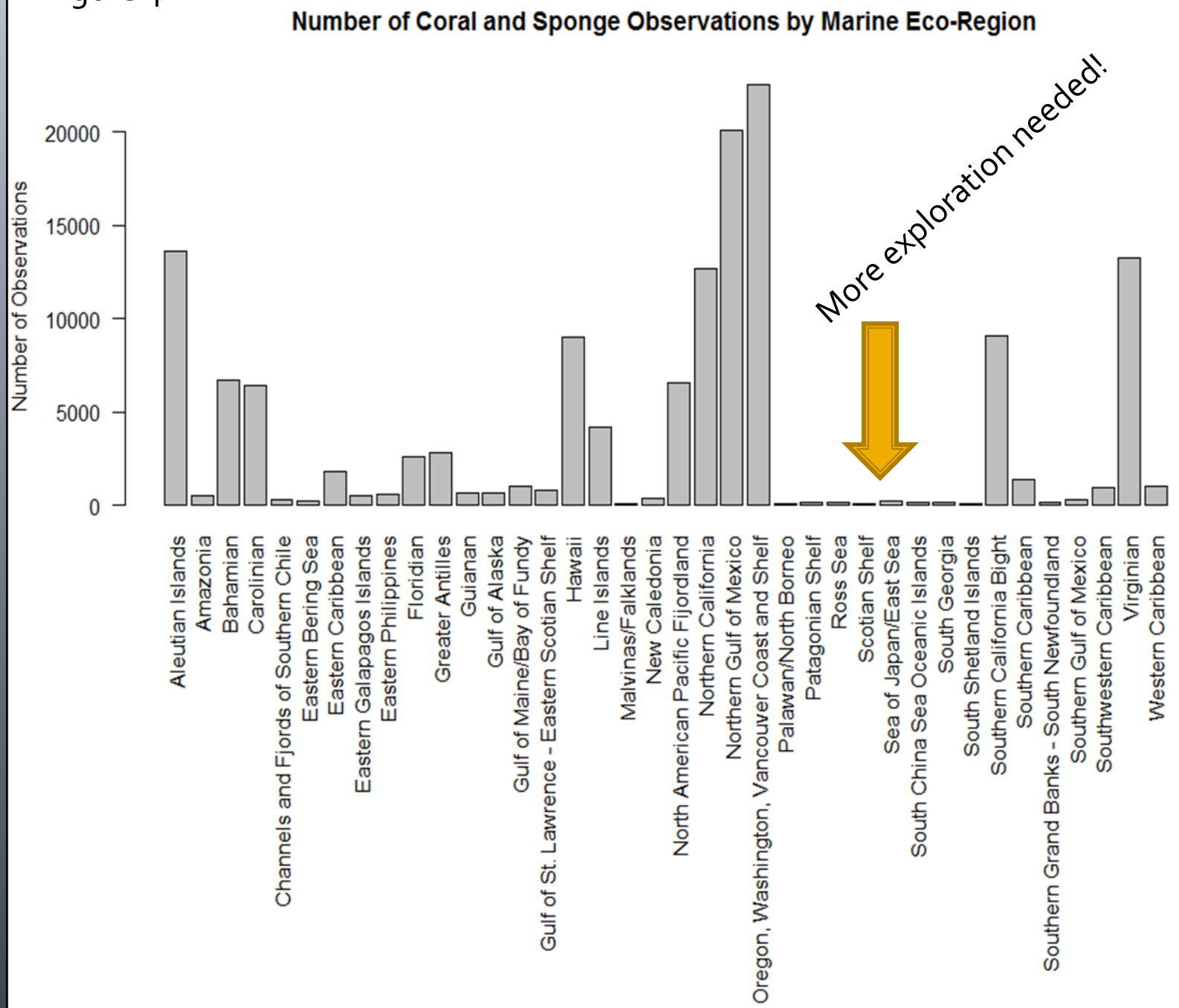

1
2
3
4
5
6

Figure 3

Marine Eco-Region's with >100 Observations	Number of Species	Shannon-Weaver Diversity
Floridian	132	3.97
Greater Antilles	166	3.91
Eastern Caribbean	130	3.65
Bahamian	184	3.57
Western Caribbean	84	3.57
Hawaii	183	3.41
Southern Caribbean	75	3.25
New Caledonia	35	3.14
Carolinian	126	3.04
Southwestern Caribbean	79	3.02
Northern Gulf of Mexico	169	2.90
Southern Gulf of Mexico	31	2.90
Eastern Galapagos Islands	26	2.68
Guianan	54	2.63
Gulf of Maine/Bay of Fundy	49	2.56
Southern California Bight	47	2.50
Scotian Shelf	18	2.20
Malvinas/Falklands	14	2.08
South Georgia	18	2.04
Channels and Fjords of Southern Chile	16	1.89
South Shetland Islands	9	1.77
Amazonia	25	1.51
Palawan/North Borneo	12	1.34
Oregon, Washington, Vancouver Coast and Shelf	38	1.33
Aleutian Islands	60	1.30
Virginian	44	1.27
Eastern Bering Sea	10	1.27

Figure 4


Number of Coral and Sponge Observations by Marine Eco-Region
Number of Observations
0
5000
10000
15000
20000
More exploration needed!
Aleutian Islands
Amazonia
Bahamian
Carolinian
Channels and Fjords of Southern Chile
Eastern Bering Sea
Eastern Caribbean
Eastern Galapagos Islands
Eastern Philippines
Floridian
Greater Antilles
Guianan
Gulf of Alaska
Gulf of Maine/Bay of Fundy
Gulf of St. Lawrence - Eastern Scotian Shelf
Hawaii
Line Islands
Malvinas/Falklands
New Caledonia
North American Pacific Fijordland
Northern California
Northern Gulf of Mexico
Oregon, Washington, Vancouver Coast and Shelf
Palawan/North Borneo
Patagonian Shelf
Ross Sea
Scotian Shelf
Sea of Japan/East Sea
South China Sea Oceanic Islands
South Georgia
South Shetland Islands
Southern California Bight
Southern Caribbean
Southern Grand Banks - South Newfoundland
Southern Gulf of Mexico
Southwestern Caribbean
Virginian
Western Caribbean

Conclusion: Community Analysis

- Eco-regional community and diversity differences are readily apparent from the cluster and NMDS ordinations.
- Six major community types emerged (with subgroupings that need further exploration).
- Differences in sampling effort between eco-regions is a major confounding factor in the analysis.
- This initial look at community differences reveals the convenience and advantage of having a global database that is regularly updated and conforms to a standard schema (Darwin Core).

Next Steps: Community Analysis

- Next analysis will use ***ESRI's Ecological Marine Units*** as the site boundaries. (3D biogeographic groupings with environmental envelopes.)
- Sampling bias between eco-regions will be further quantified and explored.
- Sharing of R code. (get in touch!)
- This is just a start. We would love to get additional collaborators involved!

Overall Conclusions

- High utility is realized from the creation of a ***one stop (value added) database*** for deep sea corals and sponges.
- Easy to contribute data: Simplified template-based approach for data contributors! We need your data.
- Standardization leads to greater scientific insight and synthesis!
- Look for:
  - ***Quarterly updates of data – this thing is ALIVE!***
  - New integrations with new distribution platforms
  - New synthesis and visualization products
  - New science and management application examples

Questions? Comments?

Deep Sea Coral Research and Technology Program

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We Need Your Data and Feedback to Improve!

References

- Hourigan, T. F., P. J. Etnoyer, R. P. McGuinn, C. Whitmire, D. Dorfman, M. Dornback, S. Cross, D. Sallis. 2015. An Introduction to NOAA's National Database for Deep-Sea Corals and Sponges. NOAA Technical Memorandum NOS NCCOS 191. 26 pp. Silver Spring, MD.
- Moustahfid, H.; Potemra, J.; Goldstein, P.; Mendelssohn, R.; DesRochers, A. 2011. "Making United States Integrated Ocean Observing System (U.S. IOOS) inclusive of marine biological resources," OCEANS 2011, pp 1-9
- Oksanen, J., et al., (2016). Vegan: Community Ecology Package. R package version 2.4-0. http://CRAN.R-project.org/package=vegan
- Spalding, M., et al., Marine Ecoregions of the World: A Bio-regionalization of Coastal and Shelf Areas. BioScience (2007) 57 (7): 573-583 doi:10.1641/B570707